An X-mode reflectometry study on the reflection point for density profile reconstruction

S. Heuraux and F. da Silva°

IJL Nancy-Université CNRS UMR 7198, BP 70239, F-54506 Vandoeuvre Cedex, France

°Associação EURATOM/IST-IPFN Instituto Superior Técnico, 1046-001 Lisboa, Portugal

The amplitude of the reflected signal rises as the frequency F reaches the first edge cut-off at $F \sim F_{ce}$ (electron cyclotron frequency) corresponding to a rapid change of the group delay occurring at the first cut-off frequency [1]. In the case of Tore Supra, below the first cut-off, the wave travels trough the plasma and the reflection occurs at the back wall while above the first cut-off the wave is reflected into the plasma. However this definition needs to be precise to define properly an initial position, using the knowledge of the magnetic field topology, assumed to be well-known. This study explores the precise position where $F=F_{ce}$ has well defined meaning and can be used to initialize the first position point of the density profile. This study has been done with two 1D full-wave codes: (i) An Helmholtz code, assuming that the probing wave reaches an asymptotic state with a negligible frequency change and (ii) a wave equation solver having a very fast frequency sweep where the electromagnetic flux conservation law induces a modification of the amplitude of the probing wave. The role of collision on the positioning of the first point has also been studied as well as the role of the density gradient length L. For this last parameter the result seems to be contra-intuitive [2] since a flat density profile gives a more precise position of the initialisation point than a steep-density profile except if the accurate threshold is applied on the reflected amplitude to determine the correct first point position. This threshold is found to be $(A-A_{\min})/(A_{\max}-A_{\min})=1/3$ in the collisionless case. If $A_{\max}$ instead of the prescribed threshold is used in the Tore Supra case 1 GHz of frequency shift can be reached that is to say a radial shift of the order of 3 cm. The role of geometrical effects will be also presented.

[1] F. Clairet, C. Bottereau, J.M. Chareau, R. Sabot *Rev Sci Instru* (2003) **74** n°3 1481-1484.
[2] R.B. White, F.F. Chen *Plasma Phys.* (1974) **16** n°7 565-587.